UNIVERSITY OF CALIFORNIA.

AGRICULTURAL EXPERIMENT STATION.

BULLETIN NO. 49.

Examinations of Soils from the Bay Region.

No. 788.—Dark gravelly loam soil, from the place of Mr. J. S. Bunnell, two and a half miles southwest of Mountain View, Santa Clara county. Mr. Bunnell writes as follows regarding the land represented by this soil: "The land has a scattering growth of live and white oak; has been in wheat for years. From indications within half a mile or less there might have been chamisal (*Adenocarpos*) upon it once. The soil is easily worked, and might be called porous, for it does not hold water like adobe soil. Less than a quarter of a mile northwest of it the red chamisal soil begins, which extends along the foot of the hills toward Searsville. A narrow strip of adobe touches my line a hundred feet or so. To the eastward we find in some places a great admixture of adobe, the section being much spotted. The place (of 30 acres) is within one-fourth mile of the foothills of the Coast Range. As to the depth of the soil, I believe it does not change for at least seven feet, as ascertained in digging a neighboring cellar."

The soil is a mouse-colored clay loam, intermixed with a good deal of gravel; some of the latter quite coarse, and both rounded and angular, the rocks shown being part white and jaspery quartz, some hard black shale, and a considerable proportion of coarse conglomeratic sandstone, the latter mostly angular. These rocks indicate a derivation from the region northward of New Almaden, and from the hills immediately adjacent. The lumps of the dry soil can be crushed between the fingers with some difficulty, and on wetting become only moderately adhesive.

Nos. 971, 972.—A very similar soil, from the place of Mr. J. A. Sladky within a short distance of Mr. Bunnell's land, was, with its subsoil, analized by Mr. M. E. Jaffa, of the Viticultural department. The soil is very similar to the above, but a little less clayey; its depth is from two to three feet, when the color changes to a lighter and more reddish tint, while the clay is somewhat increased. There appears to be no change in the charac er of this subsoil for fifteen feet.

The analysis of these soils gave the following results:

Dark Gravelly Loam, Mountain View.

	No. 788.	No. 971
Coarse material and sand	53.5	50.0
Fine earth	46.5	50.0
Total	100.0	100.0

CHEMICAL ANALYSIS.

	Soils.		Subsoil.
	No. 788.	No. 971.	No. 972.
Insol. matter	57.45	62 27	60 10
Sol. silica	7.92	7.23	8.69
Potash	1.21	1.03	.90
Soda	.82*	.21	.28
Lime	3.52	2 70	2.96
Magnesia	2 89	2.99	4.33
Br. oxide of manganese	.11	.05	.06
Perox. of Iron	6 02	8.83	9 99
Alumina	12 31	7.13	8.16
Phosphor. acid	.19	.10	.10
Sulphuric acid	.04	.02	.02
Water and or. matter	8.25	7.29	4 63
Total	100 73	99.85	100.22
Humus	3 10	2.07	.....
Av. inorganic	1.22	2.03	.....
Av. phos. acid	.08	.....	.....
Hy. moisture. ab. at 15° C.	8.32	7.87	9.16

*Determination probably too high.

These soils are especially interesting as representing the extreme western edge of the sloping, gently rolling plain that forms the western portion of the Santa Clara valley southward of Mountain View, and more particularly on the waters of Cupertino creek and the neighboring streams. Along the streams the soil is of great depth, sometimes showing hardly a perceptible change for 12 or 15 feet in depth, and the roots of trees are found penetrating freely to such depths in the gravelly material. This great depth, perviousness and perfect drainage would constitute alone no mean advantage if the soil were only of moderate fertility. But the analyses show a very high supply of plant food, surprisingly so in view of the rather markedly low percentages found on the ranges near Searsville (see bulletin No. 10, or Report of Agricultural College for 1884, P. 47). The dark,

gravelly soil here in question is a very rich one in every respect. The potash and lime percentages are unusually high, as is also the supply of humus; that of phosphoric acid is high in No. 788, and nearly half of it is shown by the analysis to be in an available condition, notwithstanding the long cultivation in grain, which should have drawn heavily upon this ingredient. In 971 and in its subsoil this ingredient is in smaller but still very fair supply. Under the circumstances the large humus percentage is an earnest of a large supply of nitrogen also.

It is true that these large percentages apply only to one-half of the soil-mass, the rest being gravel. But the depth and easy permeability of the soil more than make up for the difference, in comparison *e. g.* with an adobe soil of similar composition.

These soils may be considered as well adapted to the production of almost any fruits consistent with the local climate, and should yield heavy-bodied, spiritrous wines.

No. 882. Soil from Pacheco valley, Contra Costa county; sent by S. Farjeon, editor *Concord Sun*, Concord.

This specimen represents one of the prominent soil features of the upper Pacheco valley, which lies around the landward northern and western base of Mount Diablo, bordered by an outlying spur of the Contra Costa range. Beyond this spur, to the northwest, lies the Ignacio valley, the western branch of the Pacheco plain, which, lower down, forms an ininterrupted body of splendid farming land, from four to five miles wide between the western foothills of Mount Diablo on the southeast, and the Contra Costa hills on the northwest. Along or near the base of the latter meanders Walnut creek, the principal stream of the valley. Mount Diablo creek, heading on the mountain itself, drains the eastern portion, joining Walnut creek just before its entrance into the tules of Suisun bay, where the united streams assume the name of Pacheco creek.

The plain is dotted with large white oaks, which are especially thick near the borders of the streams. Close to the latter we generally find streaks of heavy black adobe, but farther away the soils are mostly lighter both in color and texture and more or less intermingled with gravel. Sometimes "gravel ridges" of greater or less width indicate the course of ancient channels, and gravel evidently underlies a considerable portion of the plain, facilitating its drainage. This is the more important as the prevalent character of the soils is that of clay loams, passing locally into a pretty tough adobe.

Regarding the land represented by the soil specimen under examination, Mr. Farjeon states that, while it is taken to the depth of twenty inches, wells dug in the neighborhood show no change of tint to the depth of sixty feet; showing an enormous accumulation of an evidently alluvial soil mass. "Within a mile or thereabouts of the point where the sample was taken, there is an occasional change to a kind of coarse sandy and gravelly adobe, of black or brown tint. Cereal crops around this place, wherever sown, have been very good; and fruit trees and vines, wherever set out, are doing finely and where old enough have borne heavy crops of fruit, equal in flavor and size to any grown elsewhere. Rains throughout this valley have always been good."

The sample sent is a brownish-gray clay loam, of which dry lumps cannot easily be crushed between the fingers. On wetting, the lumps soften quickly and without change of tint, and when worked the earth becomes quite adhesive. The coarse portion consists mostly of flattened particles of hard shale and quartz, well rounded on the edges.

The analysis of this soil resulted as follows:

No. 882.—Pacheco Valley Soil.

Coarse materials		10.75%
Fine earth		89.25%
Insoluable matter	63.279	72.12
Soluble silica	8.842	
Potash		.77
Soda		.57
Lime		1.69
Magnesia		2.36
Br. oxide of manganese		.17
Peroxide of iron		4.91
Alumina		12.86
Phosphoric acid		.06
Sulphuric acid		.01
Carbonic acid		.....
Water and organic matter		5.03
		100.55
Humus		1.073
Available inorganic		.898
Available phosphoric acid		.056
Hygroscop. moisture		9.050
absorbed at		°C.

The proportion of coarse material (gravel and coarse sand) shown in the above table is quite small, and probably below the average of the Pacheco plain, outside of the adobe streaks. Probably, however, the gravel percentage increases here, as elsewhere, with increasing depth, so as to render the subsoil easily penetrable to roots.

Chemically the soil shows a large supply of potash and of lime; and, as regards the latter, there can be no doubt that it is a general characteristic of the Pacheco valley soils, since lime is abundant in the rocks on the flanks of Mount Diablo, as well as on the Contra Costa range. On the banks of Walnut creek, the lower portion of the adobe, just above the gravel that underlies at some five feet depth, is full of "white gravel" or lime concretions.

The proportion of phosphoric acid is not high, although it would in any case be accounted above deficiency. But the determination of its solubility shows (under the head of "available phosphoric acid") that practically *all* of it is in the available state; so that for present purposes its upply is not very far behind (⅔) that of the rich Santa Clara valley soil, above described. The soil has also a fair supply of humus, and therefore, at present, of nitrogen. Its power

of absorbing moisture is high and, with its depth, constitutes a safeguard against drought and hot winds.

If, as it seems probable from its agreement in character with other soil samples from the Pacheco region, this soil is a fair index of the general character of the latter, its fruit product can not fail to be both abundant in quantity and high in quality. Its best general adaptation would seem to lie in the direction of pears, plums, apricots and table grapes; less in that of peaches and almonds.

No. 912. Piedmont hills soil, from the land belonging to the "Ladies' Silk Culture Society of California," on which the U. S. silk culture experiment station has been established.

This locality, as its name implies, is just within the foothills of the Contra Costa range, about two miles east of the city of Oakland, from which it is easily reached by a horse car line. The land of the society includes part of both slopes of a ridge, from which a magnificent view of the bay and the Golden Gate is had, and east of the ridge the head of a small valley, which, with the east slope of the ridge, includes the best soil of the tract, and is now being cleared for planting with mulberry trees. A scattered growth of live oaks formed the original timber, but the tract was some years ago planted with eucalyptus trees, whose vigorous growth indicates at once the good quality of the soil. The latter, however, is altogether different from that which prevails on the hills near Berkeley. Here we have almost throughout the various modifications of adobe, or more or less refractory clay loams, while at Piedmont the underlying sandstone has produced a substantial, but still quite light sandy loam, easily worked, and penetrated by roots down to and even into the soft rock underlying at various depths. The dark mouse-colored surface soil is usually from 12 to 20 inches deep, when the color changes to a more yellowish tinge and finally to the yellow of the sandstone itself. It should be stated that the latter dips at a steep angle to the northeast, so that all the moisture of the ridge is shed toward the east slope and valley, where the mulberry plantation is to be established. Hence, the valley soil is more or less moist all summer, and offers an excellent site for nursery beds.

A sample of the soil was taken about the middle of the eastward slope to the depth of 12 inches: The color, however, remains unchanged to about 20 inches. The soil is quite friable at all times, and can readily be worked the day after a rain. Its analysis resulted as follows:

No. 912.—Soil from Piedmont Hills.

Coarse materials		5.8 per cent
Fine earth		94.2 per cent
		100.0
Insoluble matter	78.431	84.22
Soluble silica	5 797	
Potash		.58
Soda		.19
Lime		.72
Magnesia		.56
Br. oxide of manganese		.19
Peroxide of iron		2.21
Alumina		6.07
Phosphoric acid		.05
Sulphuric acid		.02
Carbonic acid		....
Water and organic matter		5.54
Total		100.35
Humus		2.18
Available inorganic		.88
Available phosphoric acid		.05
Hygroscop. moisture absorbed at 15°		4.72

The coarse material of this soil consists in the main of angular fragments of the underlying sandstone, with some coarse grains of sand. It is emphatically a "colluvial" soil.

As regards its chemical composition, the plant-food percentages are very satisfactory for a soil of so sandy a nature as to yield over 84 per cent of inert matter. Potash and lime are both in good supply, while that of humus is large. The phosphoric acid percentage is low, as it is in nearly all the ridge soils of the bay country; but here again, as is the case of the Pacheco valley soil, practically the whole of it is in a soluble, or at least, available condition, a feature connected, as it seems, with the prevalently high supply of lime and humus within the redwoods region.

Nearly all the mulberries are at home on calcareous soils; the American species will even flourish on the most refractory adobe or prairie soils, provided there is abundance of lime and humus. For so sandy a soil as that at Piedmont, the supply of both is quite high, and as the land will be readily and cheaply kept in good tilth, its adaptation to the growth of the mulberry, and to the general purposes of a silk culture experiment station, seems to be as good as could readily be found under the circumstances surrounding its establishment.

Berkeley, Dec. 4, 1885. E. W. HILGARD.